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ABSTRACTS OF ARI RESEARCH PUBLICATIONS,
FY 1972 AND 1973

Emma E. Brown and Helen S. Price

OFFICE OF THE TECHNICAL DIRECTOR



U. S. Army

Research Institute for the Behavioral and Social Sciences

April 1978

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A list of the Federal depository libraries where the published ARI reports may be obtained is also given.

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Technical Paper 290

LEVEL II

ABSTRACTS OF ARI RESEARCH PUBLICATIONS, FY 1972 AND 1973

Emma E. Brown and Helen S. Price

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FOREWORD

The Army Research Institute for the Behavioral and Social Sciences (ARI) publishes a series of abstracts which summarize the research on which final or interim reports have been published during each fiscal year. The series began in Fiscal Year 1957. The present Technical Paper contains the abstracts for research publications for FY 1972 and 1973.

During this period ARI was established (1 October 1972), uniting in one organization the Army's research in personnel performance and training, human factors, and manpower and personnel-including research previously conducted in the Behavior and Systems Research Laboratory (BESRL) and the Motivation and Training Laboratory (MTL). Typical research and development activities included assessment of quantitative and qualitative manpower resources and requirements for personnel accession and distribution, and of human performance affecting military operations. Continuity in the research programs was maintained; therefore some of the research reported here was accomplished under ARI and some under BESRL and MTL.

Other ARI research has culminated in the development, over the years, of instruments to aid in the selection, classification, and utilization of Army personnel; these instruments are indexed in ARI's Psychological Testing Programs in the U.S. Army as well as Department of the Army Pamphlet 310-8, Index of Army Personnel Tests and Measures, January 1975.


Joseph Zeidner
Acting Technical Director

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ABSTRACTS OF ARI RESEARCH PUBLICATIONS, FY 1972 AND 1973

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ABSTRACTS OF ARI RESEARCH PUBLICATIONS, FY 1972 AND 1973

INTRODUCTION

The present volume of abstracts, continuing the series begun in 1957, summarizes the research publications of the Army Research Institute for the Behavioral and Social Sciences (ARI) for fiscal years 1972 and 1973. Each volume of the series provides a synopsis of research efforts which reached interim or final reporting stages during the period covered. The abstracts have been written, as far as possible, to describe the principal research findings in nontechnical terms; technical language is used to communicate efficiently the details of research analysis. Descriptions of the research program areas provide a context for the individual reports and are cross-indexed with the abstracts.

PUBLICATION CATEGORIES

ARI research publications are divided into separate, consecutively numbered categories appropriate to their intended audiences and functions.

TECHNICAL RESEARCH REPORTS describe completed research programs or projects which contribute directly to the solution of Army human factors problems in the broad areas of personnel management and enhancement of human performance, both of the individual and in the Army's manned systems. They are typically divided into two parts--a nontechnical report to management and a technical supplement.

TECHNICAL RESEARCH NOTES present technical information on research methodology or basic psychological knowledge developed out of the work program. They are primarily of interest to technically trained research workers in the Defense Department and other government agencies.

RESEARCH STUDIES, RESEARCH INVESTIGATIONS, and RESEARCH PROBLEM REVIEWS are special reports to military management, generally prepared in response to questions raised by operating agencies when early answers are needed. They may include presentations to military management, interim bases for changes in personnel operations, and bases for research decisions. Distribution is usually limited to operating agencies with a direct interest in the content.

RESEARCH MEMORANDUMS are informal, intra-agency reports on technical research problems. They include the following types of content: details on the construction of experimental instruments, fragmentary or incidental data, and methodological developments relating primarily to in-house technical operations. Distribution is primarily to personnel engaged in research for ARI.

DISTRIBUTION OF ARI PUBLICATIONS

Initial distribution of each report is made directly by ARI. Technical Research Reports are distributed primarily to operational and research facilities and their sponsors in the Defense Department, to other interested government agencies, to the Defense Documentation Center (DDC), and to the Library of Congress which in turn distributes to federal depository libraries. Technical Research Notes are distributed primarily to technically trained research workers, including those reached through Library of Congress channels.

Qualified requestors may obtain copies of Technical Research Reports and Technical Research Notes directly from DDC (Cameron Station, Alexandria, Va. 22314). Anyone may obtain these documents from the National Technical Information Service (NTIS), Department of Commerce, Springfield, Va. 22151. The six-digit AD number given for each report is the accession number which should be used in requesting documents from DDC or NTIS.

Copies may also be obtained on loan from depository libraries in many metropolitan and university centers. A list of these libraries is given at the end of this publication.

Research Studies, Research Investigations, Research Problem Reviews, and Research Memorandums are operating, intra-agency administrative documents; therefore, they are rarely placed in DDC and NTIS. File copies may be maintained at ARI offices in Alexandria, Va. after the initial printed supply has been exhausted. These documents are summarized in this publication to provide a complete and more permanent record of the research projects.

ABSTRACTS OF RESEARCH PUBLICATIONS

TECHNICAL RESEARCH REPORTS

1. TRR 1170. Kenneth W. Haynam and Sidney A. Sachs (ARI) and Alan Colker and James S. Leib (CONSAD Research Corporation). SIMPO-I General Entity Simulator (GES). June 1973. AD 767 249.

The General Entity Simulator (GES), a computerized entity model, was developed to provide users of the SIMPO-I simulation package (See TRN 229) with the capability of detailed study and evaluation of many Army personnel subsystems. The GES is shaped to represent these different systems, without reprogramming, by appending an appropriately coded data deck to prescribe the order and extent of various precoded routings contained in the GES. Functions that can be simulated include accession, training, assignment, rotation, promotion, and skill acquisition. The model, designed under capacity constraints imposed by the available computer, incorporates special logic routines--file building, retrieval, and utility--that can be used in new logic routines if program changes are required. The model can simulate personnel flow between approximately 500 nodes for as many as 50,000 entities. Most programs in the GES can be used without modification from one problem to another. By modifying or changing certain subroutines, the procedural structure of the standard program deck can be altered without affecting the remainder of the simulation program. Alternatively, the modular structure allows the modeling of a total personnel system or portions of the system by bypassing certain of the procedure routines.

Development and preliminary testing of the model is described in detail.

An entity simulator can be used to take into account many different variables or to maintain records of various individual characteristics or experiences that may relate to personnel policies--a capability not present in the more general mass flow models that process groups of individuals through the system. To some extent, this more detailed analysis is attained at the expense of generality and simulation time. In many instances, the GES can itself model more general situations, provided the input data are properly structured in terms of system definition. Within the system boundaries, the analyst must specify the proper level of generality or detail. In making this choice, the tradeoff is between an amount of detail requiring longer to develop and run and a level of simplification that cannot yield meaningful results.

2. TRR 1172. William H. Helme, Louis P. Willemin, and Frances Grafton. Dimensions of leadership in a simulated combat situation. July 1971. AD 730 315.

Officer prediction research was undertaken to meet the need for improving selection and assignment of personnel for differential officer leadership positions. Objectives were (1) clearer definition of the behavioral demands of officers in different types of assignment and (2) improved methods of identifying officers or potential officers who can be expected to perform well in each of several broad domains of leadership. Analysis of duties performed by officers pointed initially to three groups of officer assignments-- combat, technical, and administrative--that appeared to call for different patterns of leader behavior.

The present Technical Research Report presents the important dimensions of officer leadership behavior derived from analysis of specific actions recorded and observed or evaluated during a three-day exercise in a simulated combat situation. A second publication (TRR 1173) presents the major psychological factors derived from officer responses to tests of the experimental Differential Officer Battery administered at entry on active duty. In the simulated combat exercise, a sample of 900 officers performed 15 missions--five combat, five technical, and five administrative. Over 2000 single observations and evaluations by a trained military staff were analyzed and assembled into over 300 scales and evaluations including total score on each mission.

Two broad domains of officer activity were clearly differentiated by the factor analysis conducted--combat leadership and technical/managerial leadership. In addition to factors reflecting the behavioral patterns in these two domains, six other major factors were identified: team leadership as opposed to personal resourcefulness, command of men as opposed to individual technical effectiveness, mission persistence, executive direction, tactical staff skills, and technical staff skills.

Both cognitive and noncognitive aspects of leader behavior were delineated. In the combat leader, the cognitive aspect is shown in the use he makes of his tactical skills; in the technical/managerial leader, by his use of technical skills. The heavy noncognitive element in combat leadership rests primarily on forcefulness in command of men, on team leadership or personal resourcefulness, and on persistence in accomplishing the mission. In technical/managerial leadership, the noncognitive element is evidenced in executive direction, plus--as in combat leadership--persistence in mission accomplishment.

Research on officer prediction has provided measures for more than precommissioning use. The dimensions of officer behavior delineated shape the constructs entering the research effort, to develop an officer selection and evaluation system that effectively serves the changing

pattern of officer career development. Research methodology has been developed to support the measurement of performance by means that also consider the elusive noncognitive and situational elements influencing performance.

3. TRR 1173. William H. Helme, Louis P. Willemin, and Roberta W. Day. Psychological factors measured in the Differential Officer Battery. July 1971. AD 737 685.

An essential step in research to improve officer selection and assignment identified and delineated major officer characteristics measured by the experimental Differential Officer Battery, covering a wide range of abilities, interests, background, and judgmental and attitudinal responses (See TRR 1172). The Differential Officer Battery, as administered to a sample of newly commissioned officers, was designed to yield measures differentiating leadership potential in three domains--combat, technical, and administrative. The present analysis dealt exclusively with the internal structure of the battery.

Officer responses to the over 1700 items in the battery were subjected to a sequence of factor analyses in order to structure the content into a manageable number of reliable and scorable scales having potential for predicting the success of officers in combat and technical/managerial assignments as well as in general command duty. The first analysis was within major segments of the battery to arrive at reliable and homogeneous psychological scales. A factor analysis across the scales yielded 17 interpretable factors, of which the major ones were mechanical technology, combat leadership, administration, general knowledge, science, and managerial leadership. Factors relating to outdoor activity, personal adjustment, sports, aesthetic-intellectual, and supervision were moderately well defined. Also identified, but less well defined, were factors concerned with social-economic advantage, leadership readiness, authority and structure, easygoingness, strict command, and political orientation.

Scales based on these analyses constituted the experimental predictors of officer performance from which an operational battery for officer selection and career classification was derived.

4. TRR 1174 (C). Joyce L. House and Stanley L. Cohen. Quantitative evaluation of current procedures in voice processing (unclassified title). July 1971. CONFIDENTIAL. AD 516 989.

(U) The complex weapons and surveillance systems of the modern army have created a series of jobs requiring operators to monitor instrument panels, radarscopes, communication nets, and other types of signal detection apparatus. The monitor performance research program deals with the many personal, environmental, and situational variables affecting human performance in the detection and analysis of a broad variety of signals. The primary objective is to improve performance in Army monitor jobs, with emphasis on developing and testing new work methods.

(U) An important segment of the research is devoted to human factors studies in communication analysis and processing. The present report describes a study devoted to methods of gisting--that is, abstracting the essential elements of a voice communication--as a means of identifying problems in extracting information from voice communications.

5. TRR 1175. James H. Banks and Jack J. Sternberg (ARI) and William A. Dalhamer and Barry Cohen (Manned Systems Sciences, Inc). Effects of STANO sensors on small unit effectiveness--Part II. February 1972. AD 900 256.

Continuing research conducted by the Army Research Institute in the STANO performance optimization program is directed toward enhancement of combat soldier performance in night operations using night vision devices and related sensors. The program is executed by the ARI Field Unit at Fort Ord, Calif., in conjunction with and with the support of combat developments experimentation personnel. The present experiment was designed to provide comparative performance data on the effectiveness of small units utilizing six different mixes of STANO sensors.

Technical Research Note 237 reported the findings of Part I of the experiment, in which three mixes were empirically tested and others analytically evaluated under two sensor deployment conditions in a linear defense situation. In Part II, reported here, three additional mixes were tested under the same two conditions in a linear defense situation and in a reconnaissance patrol situation. Testing was conducted under starlight and three-quarter to full-moon illumination. Eighteen squads were tested on each of three mixes (with three sensors per mix) for two tactical deployments of the sensors. For each mix, 144 targets were presented under starlight, 72 under moonlight. Data were analyzed in terms of observer reports, reports to squad leader, and reports to platoon leader. Comparisons were made for individual sensors, mixes involving two sensors, and mixes involving three sensors. The four sensors tested were the Starlight Scope, AN/PVS-2 (SS); the Listening Post Surveillance Device, AN PPS-14 (PPS-14); the Patrol Seismic Intrusion Device, AN/GSQ-151 (PSID); and the Hand-Held Thermal Viewer, AN/PAS-7 (HHTV).

A higher quality of target information was obtained with the mix of one PSID, one SS, and one HHTV than with the other mixes tested. All mixes showed a substantial loss of information as reports were transmitted from squad leader to platoon leader, particularly with regard to quality of information. The number of false reports was small for all sensors and mixes but was higher with the HHTV than with the other sensors. Results suggested the need for improved procedures or more adequate training, or both.

TRR 1176. Joanne M. Witt. DISTRO II--Distribution rotation model. April 1973. AD 760 485.

Personnel deployment in the Army, as in other personnel systems, is a function of two major factors--requirements of system constraints and policy considerations, and personnel resources reflecting characteristics of individuals in the system. These requirements often appear well-balanced, whereas in reality variables such as rotation policies and area needs may interact to reduce drastically the pool of deployable personnel. The problem for management is one of matching resources with system requirements while allowing all relevant constraints to interact. Army Research Institute personnel have developed a succession of computerized models for use in dealing with personnel distribution problems.

The DISTRO II model described in the present report is essentially a modification of the General Matrix Manipulator (described in TRR 1165). The DISTRO II enables Army personnel management to predict more accurately the effects of selected policy-related factors on the nondeployability of personnel. Deployability characteristics of the Army are calculated through simulation of priority groups and distribution areas. Differential deployability is represented by three categories of personnel: (1) not deployable overseas, available for CONUS assignments only (NOS); (2) not deployable to short tour, available for CONUS and long tour assignments (NST); and (3) not restricted, generally available for assignment (IAV). Thus, the DISTRO II expands the capability of the General Matrix Manipulator by (1) broadening the definition of deployability by accounting for additional policy-caused factors in nondeployability; (2) relating world-wide availability of personnel to tour area manning levels; (3) extending simulation to priority groups; and (4) filling tour area requirements in advance.

7. TRR 1177. Milton H. Maier and Edmund F. Fuchs. An improved differential Army classification system. April 1972. AD 748 802.

As part of the overall effort to assist the Army in making best use of the skills and aptitudes of its enlisted personnel, a new Army Classification Battery (ACB) and aptitude area system was developed, resulting in improved measures of potential for various Army job areas. The present Technical Research Report describes the psychological test battery and the aptitude areas in relation to the Army's structure and assesses the operational effects of the new measures on the selection and utilization of enlisted input.

Experimental and operational ACB tests were administered to about 25,000 men in training courses for over 100 Military Occupational Specialties (MOS). Tests were evaluated in terms of how well they predicted success in MOS training. Through the ensuing statistical analysis, an improved Army Classification Battery was developed which provides more accurate measures of trainability in the courses.

Army MOS were formed into groups on the basis of homogeneity of aptitudes and abilities relevant to job success, and aptitude area composites differentially predictive of success in the MOS groups were defined. Empirical data on the validity of the new aptitude areas were translated into estimates of the effect of the battery on attrition in training. Computer runs on simulated input samples provided the basis for estimating the number of individuals expected to perform at varying levels of productivity. The new battery, consisting of 13 tests yielding 16 scores and combined into nine aptitude area composites, was found to be on the average about 20% more valid than the prior measures in matching capabilities with requirements for success in training.

The new composites are more complex than the preceding ones. Each composite has at least one test of general ability. The effect is to spread general ability more equitably across all occupational areas. Reading ability is included in each composite, every composite having at least three tests that require the ability to read the items before the questions can be understood. This reading requirement and the greater emphasis on general mental ability are consistent with the increased complexity of modern training courses, and are essential if the Army's enlisted personnel are to keep up with increasingly sophisticated equipment, concepts, and procedures.

TECHNICAL RESEARCH NOTES

8. TRN 225. Milton H. Maier. Effects of educational level on prediction of training success with the ACB. June 1972. AD 746 994.

The Army Classification Battery (ACB) has over a twenty-year period proved effective in predicting success in Army enlisted training courses. However, possible differences in validity for various subgroups of the input population have not been the explicit subject of research. The present analysis was designed to determine whether ACB scores are equally effective as predictors of training success for enlisted personnel of different educational levels, particularly for significant subgroups such as non-high school graduates and college graduates.

Using data from extensive research on the Army Classification Battery conducted on 25,000 enlisted men in over 100 Military Occupational Specialty training courses, samples of men at each of four educational levels were formed: less than high school graduation, high school graduation, some college, college graduation. ACB scores and final training course grades were analyzed for the various samples to determine whether the predictors are equally effective for the different educational groups. Assumptions underlying the operational use of ACB test scores were tested--equality of standard errors of estimate, parallel slopes of the regression lines, correspondence of intercepts of the regression lines (using the Gulliksen-Wilks analysis of covariance technique).

A given increase in ACB test scores was found to result in the same proportional increase in predicted course performance for each of the educational levels. However, the same predictor score resulted in a different level of predicted course performance for the non-high school graduate compared to the college graduate. The course performance of the college graduate is consistently underestimated and that of the non-high school graduate tends to be overestimated, even though the college graduate has a much higher level of aptitude test score. For the less well educated, the ACB measures predict higher training performance than the individual is likely to achieve. The training performance of enlisted men could probably be predicted more effectively by including level of education in the aptitude area composites used in classification, although many other factors enter into the prediction.

9. TRN 227. Leon H. Nawrocki. Alpha-numeric versus graphic displays in a problem-solving task. September 1972. AD 748 799.

To assist commanders and their staffs in the assimilation of tactical information, data must be displayed as efficiently as possible. Such information is typically displayed either in tables made up of numbers and letters (alpha-numeric) or on maps employing standard military symbols (graphic). The present experiment was designed to evaluate, in terms of speed and accuracy of information assimilation, alternative display modes for presenting information in an Army information processing system. The immediate objective was to determine if the two display modes affect performance differentially for a range of memory requirements.

At least two circumstances impose memory requirements on a field commander. A limited time to reach a decision may force him to use only his memory of previous information relevant to the problem; or the complexity of the information displayed may impose a severe memory load upon the decision maker. Alpha-numeric and graphic display modes were selected for comparison in the context of two basic task requirements: (1) need to base a decision on memory of information previously displayed versus no memory requirement, and (2) complexity of information to be remembered (memory load).

No clear-cut advantage in speed or accuracy was noted with either display mode when memory of displayed material was required. When memory was not required, alpha-numeric displays resulted in fewer errors of omission than did graphic displays, indicating that the display mode used in an information processing system may influence the relative proportions of different kinds of error made. Hence, choice of display may be primarily one of cost consideration if overall time and accuracy are determinants of system performance. If system output reflects the specific types of error that are produced, then type of display may be of greater importance to the tactical decision.

10. TRN 229. Richard L. Krumm, James E. Robins, and Thomas G. Ryan (Bunker-Ramo). Research on tactical military decision making: III. Predictor variables and situation measures. May 1973. AD 765 457.

Evaluation of human performance in command information systems depends upon relevant and objective performance measures. Such measures permit identification of factors contributing to the overall success or failure of the system as well as to the evaluation of the capabilities of the system or subsystem. The present report describes research to develop a scenario for a test of tactical decision making and to derive methods for scoring the decisionmaking process (in addition to the decision) which, when validated, will be available for use in manned systems research to improve tactical decisionmaking.

Experimentation was conducted by ARI's Simulated Tactical Operations System (SIMTOS) facility. A test scenario was prepared and administered individually to 20 senior field grade officers. Each subject, acting as division operations officer, was required to write a defense plan for his division sector against an expected attack by two mechanized infantry divisions. Scoring standards were based on lesson plans obtained from the US Army Command and General Staff College (CGSC) at Fort Leavenworth. The scenario was presented using cathode ray tube displays, computer driven typewriters, and random access slide projection equipment. Defense plans were scored using the CGSC school solutions as criteria.

Results demonstrated the practicality of developing a priori scoring standards for complex decisionmaking tasks. A combination of four predictor scores--experience, ability, decision process pattern, and significant facts--was highly correlated with criterion score. The measure of decision quality developed was helpful in designing a more appropriate scenario for assessing the impact of various command information system variables in a situational setting (the systems measurement bed) provided by SIMTOS.

11. TRN 230. Harold Martinek and Richard E. Hilligoss (ARI) and Bruce Harrington (North American Rockwell Information Systems). Effectiveness of an error key for image interpretation in Vietnam. September 1972. AD 752 437.

Image interpreters traditionally use a wide variety of informal and formal references in performing their tasks. Informal references may be notes, sketches, or annotated photographs. Formal references (keys) are pictorial depictions of various targets under varying conditions. The key serves as a standard for comparison of a suspect target with a known target. Keys are particularly useful when image quality is marginal, when the target to be identified is atypical of its class, or when the target is one seldom encountered in normal work.

The experimentation reported here was undertaken to construct and validate a new kind of reference--an error key--which explains what the objects which resemble the target really are and in what ways they differ from the target. The new key was constructed from operational imagery with annotations pointing out types of error to be avoided. Evaluation used trained interpreters to determine if use of the error key would achieve the following results: (1) increase the number of right responses, (2) decrease the number of wrong responses, and (3) increase accuracy of identification.

Each of two matched groups of enlisted image interpreters (N=122 recent image interpreter course graduates) interpreted two sets of imagery, one set using the error key, the other without it. The error key significantly improved the accuracy of inexperienced interpreters in dealing with operational imagery--39% increase in right responses, 26% decrease in errors, and 43% increase in accuracy score. The error key also significantly improved the completeness of reporting on the imagery. Some differences in performance were noted, as a function of mission and group.

12. TRN 231. Milton H. Maier. Attrition in Ordnance School courses. September 1972. AD 751 781.

In the effort to find ways of reducing attrition in Ordnance School courses, attrition was viewed not as an isolated phenomenon but as one aspect of the entire process of classification, training, and utilization of enlisted personnel. The present research dealt with the interrelationship of aptitudes, training grades, and performance on the job.

Scores on written and performance tests given at the end of each reporting period in three Ordnance School courses--Machinist, Small Arms Repair, and Fuel and Electrical System Repair--were analyzed in relation to each other, to final course grade, and to scores on the Army Classification Battery tests. Failure rates on written and performance tests during and at end of course were analyzed to determine (1) whether written and performance tests provide similar information about the skills and knowledge of the trainees, (2) whether the same or different trainees tend to do well during the different reporting periods, and (3) whether the aptitudes required are relevant to success in the various stages of instruction.

ACB tests had the expected degree of effectiveness in predicting trainee performance (correlation coefficients in the .50's and .60's). Tests in the aptitude areas prerequisite to the courses were the best predictors for the appropriate courses. Failure rates in most written tests were high, sometimes exceeding 50% of those completing the course. On performance tests, failure rates were low, under 5% except in the Machinist course, in which over 20% failed some tests. Written and performance tests were inconsistent in numbers of individuals passing and failing; failure rates on tests at early and late reporting periods were also inconsistent.

The aptitude area composites for each course were found to be appropriate. The generally constant effectiveness of the ACB tests supported continued use of the designated composites as prerequisites.

13. TRN 232. James D. Baker. Quantitative modeling of human performance in information systems. June 1972. AD 746 096.

The present publication summarizes the conceptual development of a general purpose model of man-computer interactions in a military information processing system. The model is designed to yield measures of system performance under different mixes of personnel, equipment, and procedures. The focus is on man as operator and on the computer as tool.

Five basic and critical functions are represented in the model: screening incoming messages, transforming messages to computer format, inputting messages, assimilating the data displayed, and deciding on courses of action based on the information obtained. The impact of human performance is reflected in measures of system performance--thoroughness of information and responsiveness to user need and the quality (completeness and accuracy) of the information. Thus, the approach represented in the model provides for integrated coverage of all aspects and relationships of the man-machine interface and ties them to accepted measures of system performance.

14. TRN 233. Marshall A. Narva. Evaluation of selected pictorial characteristics of reference materials for use in image interpretation. November 1972. AD 754 567.

Three related experiments were conducted to investigate the characteristics of pictorial content of reference materials (keys) used by image interpreters, with a view to determining the most effective way of representing objects in the key. In the set of experiments, selected pictorial characteristics of image interpretation keys were varied and the effect of the variations on performance in identifying military vehicles was determined.

Each experiment dealt with different combinations of variations. Variations were: (1) photographs or line drawings or both, (2) angle of view--vertical, oblique, or both, and (3) scale of the image in the key. In the first experiment, a computer, in response to inputs from the interpreter, derived the three categories most likely to include the vehicle to be identified. The interpreter then referred to the key (in the form of a looseleaf notebook) to make the final identification. In the other two experiments, the interpreter used only the key, which contained no textual material. In each experiment, recently graduated image interpreters identified a series of 16 vehicles organized into four sets and presented in a balanced research design. Two levels of quality were used in the test imagery.

Performance was more rapid with photographs than with line drawings when the key was used with a computer-assisted selection procedure. When the key was used alone, no difference between photographs and drawings was found in speed or in number of correct identifications. No advantage was obtained by presenting more than one viewing angle nor by presenting photographs and schematic representations together. Reduced scale in the key images required more identification time, but did not result in greater accuracy. A net result of the experiments was to permit greater leeway in the materials included in keys and in the manner of presentation.

15. TRN 234. R. Kause and J. A. Thomas (Goodyear Aerospace Corporation) and T. E. Jeffrey (ARI). Coordinate determination of SLAR imaged features. April 1973. AD 759 495.

Certain Army aircraft have for some time been able to provide means for real-time or near real-time image interpretation. At first, this feature was utilized primarily to help the airborne sensor operator adjust his equipment so as to insure imagery of optimal or at least usable quality. The demand for quick reaction to fleeting targets led to use of these inflight displays for detecting target and reporting targets and their locations to ground installations.

The present publication deals with preliminary research to improve the performance of operators in interpreting side-looking airborne radar (SLAR) imagery. Objectives were to determine how accurately operators can specify coordinates for tactical images in such imagery and to find how target detection, location, and identification is affected by sensor type, means of determining ground location, and type of coordinates used to report location.

In a simulated near real-time situation, 22 school-trained interpreters were given two tasks: (1) to identify and provide location coordinates for targets annotated on the imagery (directed search) and (2) to detect, identify, and locate tactical targets on unannotated imagery (free search). Each task was performed using imagery acquired by a noncoherent radar system and again using imagery acquired by a coherent system. Other factors varied were topographic maps vs radar mosaics for determining ground location and Universal Transverse Mercator (UTM) vs Geographic (GEO) coordinates in reporting.

Neither directed nor free search resulted in location data that met general operational requirements for accuracy. In both directed and free search, accuracy and completeness of target identification were significantly better with noncoherent imagery. In free search, no differences were found across sensors for accuracy and completeness. Over the entire range of location errors, the median error was 4,000 meters for those reporting GEO coordinates, 5,900 for those reporting UTM coordinates. These and other findings pointed to the need for development of improved operator techniques so that targets detected in SLAR imagery could be more accurately located.

16. TRN 235. R. Kause and J. A. Thomas (Goodyear Aerospace Corporation) and T. E. Jeffrey (ARI). Effect of training on coordinate determination of SLAR imaged features. April 1973. AD 762 342.

The Army's surveillance aircraft can be equipped with a sidelooking airborne radar system (SLAR) capable of producing transparent SLAR imagery which the operator can view in flight. To realize this potential, the inflight observer must be able to detect targets in the imagery, identify the objects, determine location data, and report the information to some airborne or ground-based intelligence center. To this end, research was undertaken to develop a trainee-participation instructional program with immediate feedback and to evaluate the performance of operators in locating targets.

A four-phase unit of instruction was devised in which imagery, map scale, and orientation cues were varied. Feedback was provided after each exercise. After completing this training program, 12 school-trained interpreters were tested in two tasks requiring them to identify and locate map coordinates for annotated targets (directed search) on imagery acquired by both coherent and noncoherent radar systems. The second task involved free search, in which interpreters were required to detect, identify, and determine location data for all targets on the imagery. Performance of this experimental group was compared with that of a control group who were given only lecture training on the properties of SLAR imagery.

Interpreters given the experimental training program determined location data with greater precision than did the control group. Identification accuracy scores for the experimental group were lower than for the control group, a difference attributed to the emphasis in the training group on the importance of determining target location. The absolute magnitude of location errors in both groups, however, exceeded that specified as operationally acceptable.

TRN 236. Joyce L. House. A comparison of two methods of of gisting. March 1972. AD 743 185.

An important segment of ARI research on monitor performance is devoted to human factors studies in communication analysis and processing. The present publication reports on research to evaluate two experimental methods of gisting--that is, abstracting the essential elements of a voice message--in comparison with baseline performance in simulated on-line gisting.

Twenty-four communications processors were each tested using two methods of gisting. In one method (free repeat), the processor listened once to the complete message with no option to stop or replay, preparing as complete a gist as he could, and was then free to replay the tape as he judged necessary to complete the gist. In the second method (forced repeat), the processor listened to the complete message once and prepared as complete a gist as he could. He then listened to the complete message five additional times with no option to stop or replay.

The free-repeat method produced a higher quality gist and a higher percentage of key items correctly reported than did the forced repeat method. The free repeat method also took less time to produce a complete gist. However, the time spent on each repetition was controlled in the forced repeat method. In both methods, repetition produced gains in number of key items reported correctly and in the overall quality of the gist.

18. TRN 237. Jack J. Sternberg, John P. Farrell, Jr., and James H. Banks, Jr. Effects of STANO sensors on small unit effectiveness--Part I. January 1972. AD 744 443.

A large number of sensors have been developed for the purpose of enhancing the Army's night operations capabilities. The present experimentation was designed to provide military management with information needed for the selection and utilization of available sensors.

In Part I of the experiment, the performance of squads using three mixes of sensors was evaluated under two sensor deployment conditions in a linear defense situation. In Part II (TRR 1175), other mixes were used and a reconnaissance patrol situation was added. Squad performance was evaluated in terms of timeliness, quality, and detection of the targets incorporated in the test material. Testing was conducted under starlight conditions. With two-sensor mixes, differences in detection performance were minimal. Addition of a third sensor slightly increased the squad's detection capability. In timeliness and quality of detection, however, there was a difference between two- and three-sensor mixes, and also with the types of sensor in the mixes. The number of false reports was small for all sensors and mixes. Information obtained by each sensor operator was reported to the squad leader without meaningful loss, but substantial degradation of information quantity and quality occurred in transmission from squad leader to platoon leader. The loss in target acquisition due to faulty communication procedures suggests the need for improved procedures or training or both at the squad-platoon level.

19. TRN 238. Sidney Epstein (System Development Corporation) and T. E. Jeffrey (ARI). Common area demarcation, target annotation, and target lists as aids in change detection. March 1973. AD 761 128.

Screening and image interpretation methods are developed to enable an interpretation facility to process rapidly the vastly increased amounts and different kinds of aerial imagery obtained through advanced acquisition techniques. The present publication reports on experimentation to improve performance in detecting changes that may have occurred in a given area between photographic reconnaissance missions--specifically, to determine whether change detection is improved by (1) demarcation of common areas on early and late imagery, (2) annotation of targets on early imagery, and (3) use of a list of targets appearing on the early imagery. Image interpreters (N = 88) were given a task of change

detection on nine pairs of early and late photographs. Eleven interpreters were assigned to each of eight treatment combinations of three variables. Performance was evaluated in terms of number of correct change detections with respect to "unchanged," "gone," and "new" targets, number of erroneous detections, and total working time.

Demarcation of common areas on early and late imagery did not significantly affect detection performance. Use of target annotations on the early cover appears useful when attainment of the maximum number of correct change statements without significant increase in processing time is important. However, the number of target misidentifications associated with correct detections may be significantly increased. Combined use of target annotations and target lists appears to maximize the number of correct change detections and is justified when time permits.

20. TRN 239. Milton H. Maier. Development and evaluation of a new ACB and aptitude area system. September 1972. AD 751 761.

As part of a comprehensive program to maintain the effectiveness of the Army Classification Battery and to keep it up to date, a new ACB and aptitude area system was developed that resulted in improved system of classification for training and jobs. A description of the new psychological test battery and aptitude areas and an assessment of their effectiveness in relation to the utilization and performance of Army enlisted personnel was published in TRR 1177. The present publication deals with research to evaluate a large number of tests as predictors of success in the different groups of Military Occupational Specialties (MOS) and to select tests for the aptitude area composites.

Experimental tests and tests of the operational ACB, administered to about 25,000 men in over 100 MOS training courses, were evaluated against performance in the training course. Validity coefficients of the variables for final course grades were computed and corrected to reflect population values. Regression equations for all tests were computed in each MOS sample. MOS judged similar in job demands and showing similar test validity patterns were combined. For each MOS group, a sequence of test selections was performed to determine which tests contributed significantly to validity.

The resulting battery consisted of 16 measures yielding nine aptitude area scores. Each aptitude area consisted of from three to five tests, each unit weighted. Through simulation runs, estimates were derived of the operational effects of introducing the new classification system.

Findings indicated that the new Army Classification Battery and aptitude areas are superior to those of the previous system. Average validity of the new aptitude area composites across all MOS groups was found to be higher than that of the previous composites.

Supporting statistical analyses are provided in detailed tables in the appendixes.

21. TRN 241. Emma E. Brown. Abstracts of BESRL research publications--FY 1971. December 1971. AD 748 800.

Research publications prepared and released by BESRL (now the Army Research Institute for the Behavioral and Social Sciences) in FY 1971 are identified by ARI publication number as well as by AD number for retrieval from the National Technical Information Service or Defense Documentation Center. Included are 5 Technical Research Reports, 1 Technical Report, 7 Technical Research Notes, 1 Research Problem Review, 8 Research Studies and 7 Research Memorandums. Program areas included in the organization's Work Program for FY 1971 are briefly described and references to relevant abstracts are noted by number. Depository libraries which were furnished copies of the Technical Research Reports and Technical Research Notes are listed.

22. TRN 243. L. H. Nawrocki. Graphic versus tote display of information in a simulated tactical operations system. June 1973. AD 766 217.

To assist commanders in making tactical decisions consistent with rapid change and succession of events, information on military operations must be processed efficiently and used effectively. To meet this need, the Army continues to develop automated systems for receipt, processing, storage, retrieval, and display of different types and vast amounts of military data. Research is also needed to determine how human abilities can be utilized to enable the command information processing systems to function with maximum effectiveness. The research reported here compared graphic and tote display modes used in computer-aided tactical information processing systems with respect to the speed and quality of the decisions reached on the basis of the information displayed.

In the context of ARI's Simulated Tactical Operations System, two groups of officers (14 in each group) were presented a command decision task. For one group, information requested by the officer from the data base was presented in graphic format emphasizing spatial and symbolic coding. For the other group, the data were presented in tote form emphasizing tabular arrangement and alphanumeric coding. Evaluation was in terms of speed and accuracy of the final decision and number of non-redundant facts accessed by the officer.

Groups using the two methods did not differ significantly in results achieved. The more economical tote display form should therefore be used wherever feasible. Where graphic displays are used, the complexity and density of information presented can be considerably reduced by conversion to a form suitable for cathode ray tube (CRT) or printout.

23. TRN 244. Robert W. Stephenson (American Institutes for Research). A taxonomic base for future management information and decision systems: A common language for resource and requirement planning. October 1972. AD 757 794.

A common language, one that will improve communication between resource planners and requirement planners and will facilitate the integration of information in centralized data banks, is a vital aspect of new management information and decision systems. The present publication outlines a tentative set of plans for such a language. Army management and decision systems are reviewed and various ways of bridging the gap between individual performance and organizational performance are analyzed. A new set of requirement planning procedures is presented in which requirement planners would use terms that are directly translatable into resource planning terms.

The overall approach is based on the assumption that a grouping of work activities more specific than a Military Occupational Specialty (MOS) and more comprehensive than a task is needed to meet the needs of and improve communications between personnel resource and requirement planners.

The proposed unit--called a "duty module"--is designed to enable operational personnel requirements at the organizational field level to be matched effectively with personnel resources. The duty module would permit adaptation of both manning configurations and requisition strategies to resource limitations.

24. TRN 245. Thomas E. Jeffrey. Effect of photo degradation on interpreter performance. June 1973. AD 763 908.

In a long-term project to develop a systematic means of evaluating imagery for interpretability--an image quality catalog, in effect--research was conducted to determine how interpreter performance is affected by variations in the character of the image. For the experiment reported here, the effect of photo scale (4 levels), haze (3 levels), and image motion resulting in blur (4 levels) on interpreter performance was assessed. Criteria were the accuracy and completeness with which trained interpreters detected and identified tactical targets presented in operationally obtained imagery.

When variations in photo scale, haze, and blur were present separately in photographic transparencies, there was little difference in target detection. When two or more of these sources of degradation were present simultaneously, target detection deteriorated markedly. When photo scale was small, the effect of other sources of degradation on interpreter performance was significantly greater than when photo scale was large. Target identification accuracy and completeness were significantly reduced by either unidimensional or multidimensional degrading conditions of the kind introduced in the experiment. In general, degradation of overall target detection accuracy was more often due to erroneous classification of non-targets as targets than to classification of targets as non-targets.

RESEARCH STUDY

25. RS 71-10. Jerrold M. Levine, Tania Romanshko, and Edwin A. Fleishman (American Institutes for Research). Development of a taxonomy of human performance: Evaluation of an abilities classification system for integrating and generalizing research findings. December 1971.

The research program as a whole was designed to develop and evaluate new systems for describing and classifying tasks so as to improve the generalization of research results about human performance, and to develop a common language that would help organize human performance for use in training, equipment design, and personnel selection. The effort represents one of the few attempts to find ways to bridge the gap between research on human performance and application of this research to the real world of personnel and human factors decisions. The segment of the program reported here was undertaken to assess the feasibility of constructing a data base founded on an abilities classification system to improve generalization of research findings about human performance. The abilities approach was judged to be viable and useful.

RESEARCH INVESTIGATIONS

26. RI 71-3. Isaac D. Orleans and Edward S. Brown III. Research on military selection and classification in Iran. December 1971.

At the request of the Advanced Research Projects Agency (ARPA), personnel of what is now the US Army Research Institute for the Behavioral and Social Sciences assisted experts of the Personnel Research Division (PRD) of the Imperial Iranian Armed Forces with research on army selection and classification problems. Four test batteries were developed for the use of the Imperial Armed Forces: the Ordinary Conscript Battery for illiterates, the Ordinary Conscript Batteries for literates, tests for the selection and classification of noncommissioned officers, and selection tests for Military Academy cadets. The first three sets of tests were useful in identifying individuals who were likely to be ineffective in military service. The tests were less useful as a basis for differential classification. The research capability of the Iranian army PRD was developed through reallocation of testing responsibilities between PRD and field services, the institution of efficient administrative procedures, and--most important--through advanced educational training and guidance in the essential phases of personnel measurement research.

27. RI 72-1. Milton H. Maier. Effects of English language training on aptitude test performance of Insular Puerto Ricans. August 1972.

The research was undertaken to meet a contemporary need for empirical data on the usefulness of English language training as preparation for taking the tests of the Army Classification Battery. The question was whether Insular Puerto Ricans who received English language training before taking the ACB would achieve higher scores on the tests than those not receiving the special training.

ACB scores obtained from men who had received six weeks of training in English did not show substantially higher measured potential for military service than did scores obtained from men who took the classification tests prior to receiving the English language training.

RESEARCH PROBLEM REVIEW

28. RPR 72-2. William H. Helme. Leadership research findings as applied to the Officer Personnel Management System. November 1972.

In a presentation before the Research and Development Human Factors Conference, Dr. Helme of ARI reviewed requirements for change to meet challenges to Army leaders as defined in then current Army analyses. Major themes characterizing these analyses were (1) the need for the officer to develop an awareness of his own leadership behaviors in relation to his superiors and subordinates, to his organization, and to the Army in its societal setting; and (2) the requirement to foster motivation and individual commitment to Army goals through selection of leaders for jobs appropriate to their styles of behavior, training of officers to handle problems flexibly, capitalizing on their individual styles of behavior, and providing multiple routes to the top of the career ladder. Dr. Helme indicated ways in which findings from ARI's research programs on officer leadership and evaluation could contribute to officer career management.

RESEARCH MEMORANDUMS

29. RM 71-4. Joanne M. Witt. SIMPO-I DISTRO--Distribution Rotation Model. December 1971.

Based on the General Matrix Manipulator (GMM) previously developed, a mass flow model was developed to provide maximum coverage of policy-caused nondeployability. The model depicts the rotation, replacement, skill acquisition, and retention aspects of a three-character Military Occupational Specialty. It used the results of the monthly projection of a basic personnel inventory by the GMM in a special computerized routing to predict distribution capabilities. Specific tour durations and service commitments, permanent and temporary deployability factors, and delays after training or en route to assignments are constraints on the availability of individuals for reassignment. Both the system simulated and the sections of the model logic that differ from the GMM

are described. Instructions for model application, a listing of the DISTRO computer programs for the model, and sample input and output are provided. A revised version of the User's Manual for the model is presented along with an interactive model user's manual.

30. RM 72-2. Thomas E. Jeffrey. Vertical photographic coverage obtainable with varying film format, film footage, lens focal length, altitude, overlap, and sidelap. June 1972.

Two tables are presented that make it possible to obtain an estimate of the linear and area coverage obtainable on 25 feet of 70 mm film using a vertical camera equipped with one of three specified focal length lenses, at altitudes ranging from 500 feet to 21,000 feet, with or without overlap on successive exposures and with or without sidelap between successive runs of the mission. Table 1 is used to determine the denominator of the photo scale of the imagery. This value is called the Photo Scale Reciprocal (PSR). PSR is used to enter Table 2 to obtain the desired area coverage. Area coverage is given in square meters and for four different conditions--no overlap and no sidelap, no overlap and 10% sidelap, 60% overlap and no sidelap, and 60% overlap and 10% sidelap. The effect of film format on the amount of ground coverage is not directly given, but can be estimated from Table 2 data. Table 1 can be used to determine the mission altitude and/or lens/focal length that must be used to obtain imagery of the desired scale.

31. RM 72-3. Marshall A. Narva. Consideration of the AR-85A Viewer-Computer for use in computer-aided instruction in image interpretation. June 1972.

The feasibility of using the AR-85A Viewer-Computer as a vehicle for administering computer-assisted training in image interpretation is assessed. The Viewer-Computer, designed to be used for mensuration and reporting functions, includes a limited computer capacity with associated limited input-output capabilities. When this capability is not being used for its principal functions, it could possibly be used as a tool for instruction. The most promising use would appear to be in identification training and in the presentation of feedback to the trainee. Small units of instruction might be feasibly incorporated at various points in the program of the individual trainee.

32. RM 72-4. Thomas E. Jeffrey and Francis J. Beck. Intelligence information from total optical color imagery. November 1972.

The present publication describes an evaluation of total optical color (TOC) imagery as a source of intelligence information. The imagery used

consisted of aerial surveillance photographs acquired over the UNDERBRUSH test range at Eglin Air Force Base. The TOC 35 mm system was compared to a system providing conventional color imagery and to a system providing monochromatic imagery. The only performance index showing significant difference between chromatic and achromatic color presentation was time taken to extract information from a slide. Black-and-white imagery required about 20% longer than the color.

Information extraction can be accomplished more rapidly from chromatic than from achromatic color imagery. The time savings is accomplished with no decrease in the accuracy or completeness of target detection and identification. Subjects expressed a preference for color imagery over black-and-white, and for imagery on conventional color film over the achromatic color imagery from the TOC system.

33. RM 72-5. Erwin W. Bedarf. Responses to job assignment and preparation/training questions by G2 Air and image interpreter personnel. October 1972.

Summaries are presented of responses to sections of two questionnaires administered to G2 Air and image interpreter personnel. Data were taken from the Aerial Surveillance and Reconnaissance Questionnaire for G2 personnel and a questionnaire of the same name administered to image interpreters. The survey was conducted as part of an effort to determine the job requirements of the two categories of personnel. A Technical Research Report covering the entire research project was being prepared during FY 1973.

34. RM 72-6. Harold Martinek and Richard E. Hilligoss. Accuracy and completeness of interpretation as a function of time for selected conditions. October 1972.

Assignment of image interpreter personnel and procedures applied must ultimately take into account the time required for varying degrees of accuracy and completeness of interpretation. A beginning was made in an effort to determine the relationship of accuracy, completeness, and time spent in interpretation under a variety of conditions and to obtain some parametric data concerning these variables. Curves are presented showing these relationships.

35. RM 72-7. J. Richard Lepkowski (System Development Corporation) and Thomas E. Jeffrey (ARI). Some factors affecting mensuration variability among image interpreters. September 1972.

From results of the exploratory study reported here, the following tentative conclusions were drawn: (1) The use of interpreter scales or reticles graduated to thousandths of a foot or in millimeters had no significant effect on mensuration variability. (2) Measurement variability for targets of the size used in these experiments did not vary significantly with target ground size. (3) Imagery scale had no

significant influence on the variability of target measurement. The significant interaction obtained in the four-factor analysis between target size and imagery scale was probably an artifact. (4) Magnification level had no significant effect on mensuration variability. (5) Measurements made using reticles appeared to be less variable than those made with an interpreter scale. (6) Interpreters tended to maintain their relative position from measurement task to measurement task with respect to the mean measurement of the group.

MAJOR RESEARCH AREAS REPRESENTED

The period covered by these abstracts extends from 1 July 1971 through 30 June 1973. During this time, the US Army Research for the Behavioral and Social Sciences was established (1 October 1972), unifying in one enlarged organization all Army activities in the area of behavioral and social science, including those previously conducted in the Behavior and Systems Research Laboratory (BESRL) and the Motivation and Training Laboratory (MTL).

Of the research reported here, some was accomplished under the newly established US Army Research Institute (ARI) and some under the preceding laboratories BESRL and MTL. Throughout the changeover, continuity in the conduct of the research mission was maintained. There was of necessity considerable reorganization of the work units to encompass the broadened research requirements and achieve an integrated research program. The research areas briefly described here are those represented by the publications abstracted in the present volume.

Units are grouped according to research area. Numbers appearing at the conclusion of each description designate the publications abstracted or listed in this volume.

PERSONNEL MANAGEMENT SYSTEMS

Under this broad area are grouped research programs dealing with the management of the Army's manpower resources, both officer and enlisted.

Research Area: Enlisted Manpower

Research focused on the Army's enlisted screening problems, seeking means of adapting measures and procedures to the changing character of the Army under the all-volunteer system, and devising ways of achieving more precise identification of potential in varying aspects of military service. 26, 27

Research Area: Differential Classification

Efforts continued to broaden the concepts of differential classification and achieve further progress in manpower utilization by analyzing the interactions between job environment and the predictive effectiveness of classification tests, the impact of the mental distribution of enlisted personnel on the performance of small units, the impact of assigning enlisted women to jobs formerly restricted to men, and the identification of individual assets not heretofore measured, among them career motivation and potential, leadership qualities, and ability to get along with others as an individual worker or as a member of a team. 7, 8, 12, 20, 26

Research Area: Officer Prediction

Differential prediction and evaluation became dominant objectives in the effort to channel officers into appropriate assignments and develop their potential so as to make best use of their abilities. Officer Prediction research provides the scientific means of identifying individuals with good leadership potential for officer training, of selecting officers for commissioning, and of evaluating their performance. The series of publications which includes TRR 1172 and 1173 records the conduct and findings of a long-term experimental program to improve the basis for selecting and developing officer leaders in accordance with their capability to meet different leadership requirements. 2, 3, 28

Research Area: Officer Career and Officer Career Counseling

The two-year period represented by the abstracts in this report saw the inception of a comprehensive program in support of the Officer Personnel Management System (OPMS). Major segments of the program include development of new and improved officer evaluation procedures for use at career decision points; development of instruments and techniques for assessing cadets' potential to perform effectively as officers; development of officer performance indices appropriate to specific personnel assignment demands and career counseling requirements, for use at regular points in an officer's career, as these evolve in the OPMS and modern volunteer Army; determination of longitudinal career progression paths; and development of techniques for career counseling and career development in relation to concepts of the OPMS and the Officer Evaluation System Master Management Plan.

Research Area: Simulation Models of Personnel Operations: SIMPO I, II, III

The primary objective was the development of new approaches and techniques for use in computerized models of manpower personnel systems for the use of management in evaluating alternative policies and procedures. Models developed have found application at the manpower policy analyst level as tools for both one-time assessment of the effects of proposed policy alternatives and for the periodic analysis of the projected state of the personnel management system resulting from a specified policy. The SIMPO effort included consultation and problem formulation for model users, adaptation and exercise of models in response to user requirements, and development of special purpose models. 1, 6, 29

Research Area: Taxonomy

A major problem which confronts the behavioral sciences is the lack of a unifying set of dimensions for describing human task performance. The absence of such a system limits the ability to relate human performance observed in one task to that observed in similar tasks. A research program was initiated to develop and evaluate systems for describing and classifying tasks and to develop a well-defined task-descriptive language for use in training, equipment design, and personnel selection. 23, 29

HUMAN PERFORMANCE ENHANCEMENT

Experimentation involves research on behavioral functions and systems aspects related to critical tasks and subtasks common to a wide variety of Army jobs. The objective is to discover general principles which can be applied to enhance individual and team performance. Typical end-products and applications are improved work methods, supervisory techniques, selection of most appropriate basis of issue and mix, work-rest cycles, information input and response output procedures.

Research Area: Monitor Performance

Research during this period concentrated on organizational, interpersonal, and motivational factors that affect the performance of operational monitor units, as well as on individual performance in monitor jobs and man-equipment interaction. One objective thus was to achieve higher levels of individual and unit effectiveness through modification in relevant features of the job environment. Another was to devise and test procedures to enhance discriminative skills in a wide variety of monitor jobs. 4, 17

Research Area: Team Performance

Research, conducted largely in the field, dealt with the development of instrumentation and methodology for effective tactical team performance, particularly in the acquisition of military targets.

Methodology and instrumentation were developed for the identification of factors which enhance operator performance with equipment used for surveillance, target acquisition, and night operations. Instrumentation has been developed by ARI field personnel at Fort Ord to provide continuous real-time data on operator performance both in training and in testing. Results provided information on the influence of various environmental and target-terrain factors on perceptual performance with STANO devices. These factors include ambient light, distance, target type, and target/background contrast. 5, 18

Research Area: Aircrew Performance

The program was based on the premise that human performance is, within certain physiological limits, capable of expansion by the development of appropriate work methods. Research concentrated on methods of utilizing hardware more effectively rather than on modifying the hardware. Specifically, visual and perceptual factors responsible for aircrew performance were identified under a variety of operational activities--low-level (Nap-of-the-earth) flight, hovering, night operations with reduced visibility, helicopter flight. Sophisticated image-enhancement displays now available provided aircrew members with several kinds of information. Research was concerned with methods of integrating the disparate information to determine effective ways of using the data.

MANNED SYSTEMS RESEARCH

The principal objective of the programs in this area is to enhance total system effectiveness by determining the optimal allocation of functions among man, machine, and man/machine combinations. New work methods, aids, and procedures are developed to capitalize on the capabilities of each element, and achieve the most appropriate configuration. This objective is approached primarily through laboratory experimentation and system simulation in which the performance of the various system components and their interactions is related to total system effectiveness.

Research Area: Command Information Processing Systems and Systems Integration

The Army has been developing complex automated tactical operations systems for the receipt, processing, storage, retrieval, and displays of vast amounts of military data. Effective performance of these systems depends ultimately on the human component. In dealing with problems in these processes, a behavioral rather than a hardware solution is sought. An experimental facility (SIMTOS) was developed in which various tactical functions can be simulated. Data were produced concerning the capabilities, limitations, and reliability of human performance that influence system development. Objective performance measures were developed for the evaluation of manned systems, and guidelines provided for the allocation of functions to man and equipment. 9, 10, 13, 22

Research Area: Advanced Surveillance Systems

The overall objective is to improve the utility of intelligence information generated by the Army's surveillance and surveillance support systems through empirical research on procedures, displays, man-machine functions, and interactions within and between these systems. Whereas an earlier project was devoted primarily to improving performance in

the interpretation of aerial imagery, effort in FY 72-73 included additional surveillance activities such as the generation of real-time and near real-time intelligence information, the operation of remotely controlled aerial reconnaissance devices, and the operation of unattended ground sensors. 11, 14, 15, 16, 19, 24, 30, 31, 32, 33, 34, 35

Research Area: Intelligence Information Processing Systems

The need for continually updating intelligence appraisals while absorbing and evaluating incoming information from a variety of sources imposes a severe burden on the intelligence analyst. The research aim is to improve the Army's capability to process tactical intelligence through application of technology to the development of data handling techniques, computer aids, work methods, analytic models and procedures, and man/machine dialogs required to support system design decisions and the formulation of operational doctrine and procedures. 33

DEPOSITORY LIBRARIES

ARI Technical Research Reports and Technical Research Notes are on file in each of the following libraries, listed by state.

ALABAMA

University of Alabama
Main Library
Box S
University, Alabama 35486

University of South Alabama Library
307 Gaillard Drive
Mobile, Alabama 36608

ARIZONA

Arizona State University
Matthews Library
Documents Librarian
Tempe, Arizona 85281

University of Arizona
University Library
Documents Service
Tuscon, Arizona 85721

CALIFORNIA

California State University
at Hayward
College Library -
Documents Department E-585
25800 Hillary Street
Hayward, California 94546

California State Library
Documents Section
Sacramento, California 95809

Documents Library
Malcolm A. Love Library
San Diego State University
San Diego, California 92182

CALIFORNIA (continued)

University of California
The Library
Documents Department
Berkeley, California 94720

University of California
The Library
Documents Department
Davis, California 95616

University of California
The Library
Government Publications Section
Irvine, California 92650

Public Affairs Service/U.S. Docs.
U.C.L.A. Library
405 Hilgard Avenue
Los Angeles, California 90024

University of California Library
Government Publications Office
Post Office Box 5900
Riverside, California 92507

Federal Documents Librarian
Government Documents Department
Stanford, California 94305

University of California
The Library
Government Publications Department
Santa Barbara, California 93106

Documents Section
The University Library
University of California
Santa Cruz, California 95060

CALIFORNIA (continued)

The Library
Government Publications Center
California State University, Chico
Chico, California 95926

The Library
Government Publications Department
California State University, Fresno
Fresno, California 93710

Library - Government Documents
California State University,
Northridge
18111 Nordhoff Street
Northridge, California 91324

The Library
University of Southern California
Government Publications
Post Office Box 77983
Los Angeles, California 90007

CONNECTICUT

University of Bridgeport
The Library
Bridgeport, Connecticut 06602

Government Publications Collection
Yale University Library
New Haven, Connecticut 06520

DELAWARE

University of Delaware
Morris Library
Documents Department
Newark, Delaware 19711

DISTRICT OF COLUMBIA

Library of Congress
Washington, D.C. 20540

Library/Acquisition
American University
Washington, D.C. 20016

DISTRICT OF COLUMBIA (continued)

Mr. James F. McGuirl
Room 3344
Civil Division Library
Department of Justice
10th & Pa. Avenue NW
Washington, D.C. 20530

FLORIDA

Library, Documents
Florida International University
Tamiami Trail
Miami, Florida 33144

Florida State University
The Library
Documents Division
Tallahassee, Florida 32306

GEORGIA

Ser & Binding Department
Robert W. Woodruff Library
Emory University
Atlanta, Georgia 30322

IDAHO

University of Idaho
Library
Moscow, Idaho 83843

ILLINOIS

University of Chicago Library
Documents Processing
1100 East 57th Street
Chicago, Illinois 60637

Milner Library/Government
Publications
Illinois State University
Normal, Illinois 61761

ILLINOIS (continued)

Government Documents Branch
Centennial Building
Illinois State Library
Springfield, Illinois 62706

Documents Section
University of Chicago at
Chicago Circle
P.O. Box 8198
Chicago, Illinois 60680

University of Illinois
The Library
Documents Division
Urbana, Illinois 61801

Northern Illinois University
The Library
Documents Department
DeKalb, Illinois 60115

Northwestern University
The Library
Documents Department
Evanston, Illinois 60201

Southern Illinois University
The General Library
Serials Department
Carbondale, Illinois 62903

Documents Librarian
Southern Illinois University
Lovejoy Library
Edwardsville, Illinois 62025

Western Illinois University
The Library
Documents Librarian
Macomb, Illinois 61455

Documents Department
Sangamon State University Library
Springfield, Illinois 62703

INDIANA

Ball State University Library
Government Publications
Muncie, Indiana 47306

Indiana State Library
Documents Librarian
140 North Senate Avenue
Indianapolis, Indiana 46204

Indiana State University
Cunningham Memorial Library
Documents Library
Terre Haute, Indiana 47809

Indiana University
The Library
Documents Librarian
Bloomington, Indiana 47401

Acquisitions Department (277449A)
Memorial Library
University of Notre Dame
Notre Dame, Indiana 46556

U.S. Documents Office
Purdue University Libraries
Lafayette, Indiana 47907

IOWA

Cowles Library
Drake University
Des Moines, Iowa 50311

University of Northern Iowa
Library Documents Collection
Cedar Falls, Iowa 50613

KANSAS

Kansas State University
The Library
Documents Division
Manhattan, Kansas 66506

KANSAS (continued)

University of Kansas
The Library
Documents Librarian
Lawrence, Kansas 66045

KENTUCKY

Government Publications Department
University of Kentucky Libraries
Lexington, Kentucky 40506

LOUISIANA

Louisiana State University
The Library
Government Documents Department
Baton Rouge, Louisiana 70803

MAINE

University of Maine
Raymond H. Fogler Library
Documents Librarian
Orono, Maine 04473

MARYLAND

National Library of Medicine
RSD-Documents Unit
8600 Rockville Pike
Bethesda, Maryland 20014

University of Maryland
McKeldin Library
Social Science Department
College Park, Maryland 20742

MASSACHUSETTS

Government Documents Section
Harvard College Library
Cambridge, Massachusetts 02138

Boston Public Library
Serials Receipts
Boston, Massachusetts 02117

MASSACHUSETTS (continued)

University of Massachusetts
Library
Government Documents Collection
Amherst, Massachusetts 01003

Williston Memorial Library
Mount Holyoke College
South Hadley, Massachusetts 01003

MICHIGAN

Central Michigan University
The Library
Documents Section
Mt. Pleasant, Michigan 48858

Detroit Public Library
5201 Woodward Avenue
Detroit, Michigan 48202

Michigan State University
The Library
Documents
East Lansing, Michigan 48823

University of Michigan
The General Library
Documents Librarian
Ann Arbor, Michigan 48104

Wayne State University
The Library
Documents Librarian
Detroit, Michigan 48202

Western Michigan University
Dwight B. Waldo Library
Documents Library
Kalamazoo, Michigan 49001

MINNESOTA

University of Minnesota Libraries
409 Wilson Library
Minneapolis, Minnesota 55455

MINNESOTA (continued)

Minneapolis Public Library
Order Department, Documents
Expediting Project
300 Nicollet Mall
Minneapolis, Minnesota 55401

MISSISSIPPI

University of Southern Mississippi
The Library
Serials - Documents
Hattiesburg, Mississippi 39401

MISSOURI

University of Missouri
The Library
Serials - Documents
Columbia, Missouri 65202

NEBRASKA

University of Nebraska
The Library
Documents Librarian
Lincoln, Nebraska 68508

NEW HAMPSHIRE

Dartmouth College
Baker Library
Reference Department
Hanover, New Hampshire 03824

Documents, The Library
University of New Hampshire
Durham, New Hampshire 03824

NEW JERSEY

Princeton University
The Library
Documents Librarian
Princeton, New Jersey 08540

NEW JERSEY (continued)

Government Publications Department
Rutgers University Library
New Brunswick, New Jersey 08901

NEW YORK

Association for the Bar of the
City of New York
42 West 114th Street
New York, New York 10036

Brooklyn College Library
Documents Division
Bedford Avenue and Avenue H
Brooklyn, New York 11210

Brooklyn Public Library
Social Science - Documents Division
Grand Army Plaza
Brooklyn, New York 11238

Cornell University
The University Libraries
Government Documents
Ithaca, New York 14850

New York Public Library
Government Documents
Fifth Avenue & 42nd Street
New York, New York 10018

Documents Service Center
Columbia University Libraries
420 West 118th St. Rm. 327
New York, New York 10027

Nassau Library System
Reference Department
Lower Concourse, Roosevelt Field
Garden City, New York 11530

Mr. Paul B. Gloeckner
Paul, Weiss, Rifkind, Wharton,
Garrison
345 Park Avenue
New York New York 10022

NEW YORK (continued)

New York State Library
Gift and Exchange Section
Albany, New York 12224

State University of New York
at Binghamton
The Library - Documents Section
Vestal Parkway East
Binghamton, New York 13901

State University of New York
at Buffalo
Lockwood Memorial Library
Documents Division
Buffalo, New York 14214

Syracuse University
The Library
Serials Division
Syracuse, New York 13210

State University of New York
at Stony Brook
Main Library, Documents Section
Stony Brook, New York 11790

United Nations Library
Acquisitions Section
Grand Central P.O. Box 2000
New York, New York 10017

Lehman College Library
Acquisitions Division
Serials Section
Bedford Park Blvd. West
Bronx, New York 10468

New York Public Library
Mid-Manhattan CC4 Branch
8 E. 40th Street
New York, New York 10016

NORTH CAROLINA

Duke University
The Library
Public Documents Division
Durham, North Carolina 27706

NORTH CAROLINA (continued)

North Carolina State University
D.H. Hill Library
Raleigh, North Carolina 27607

Serials Department
University of North Carolina
Wilson library 024-A
Chapel Hill, North Carolina 27514

OHIO

University of Cincinnati
Main Campus Library
Serials Department (Documents)
Cincinnati, Ohio 45521

Bowling Green State University
The Library
Documents Department
Bowling Green, Ohio 43402

Kent State University
The Library
Documents Librarian
Kent, Ohio 44240

Miami University
The Library
Documents Department
Oxford, Ohio 45056

Ohio State University
The University Libraries
Documents Division
1858 Neil Avenue
Columbus, Ohio 43210

Government Documents Department
Ohio University
Athens, Ohio 45701

OKLAHOMA

Central State College
Max Chambers Library
Documents Department
Edmond, Oklahoma 73034

OKLAHOMA (continued)

Oklahoma State University
The Library
Documents Librarian
Stillwater, Oklahoma 74075

OREGON

Portland State University Library
P.O. Box 1151
Portland, Oregon 97207

PENNSYLVANIA

Carnegie Library of Pittsburgh
Reference Department
Pittsburgh, Pennsylvania 15213

Free Library of Philadelphia
Department of Public Documents
Philadelphia, Pennsylvania 19103

Pennsylvania State University
The University Library
Documents
University Park, Pennsylvania 16802

Samuel Paley Library
Documents Room
Temple University
Philadelphia, Pennsylvania 19122

RHODE ISLAND

Brown University
The University Library
Documents Division
Providence, Rhode Island 02912

University of Rhode Island
The Library
Kingston, Rhode Island 02881

SOUTH CAROLINA

Documents Department
McKissick Memorial Library
University of South Carolina
Columbia, South Carolina 29208

TENNESSEE

University of Tennessee
The Library
Documents Librarian
Knoxville, Tennessee 37816

TEXAS

Documents Librarian
Tarlton Law Library
University of Texas
2500 Red River
Austin, Texas 78705

Library - Documents
University of Texas at Arlington
Arlington, Texas 76019

Dallas Public Library
Documents Librarian
Dallas, Texas 75201

Documents Acquisitions
University of Texas Library
Austin, Texas 78712

Law Library
Storey Hall
Southern Methodist University
Dallas, Texas 75275

UTAH

Brigham Young University
The Library
Documents Section
Provo, Utah 84601

UTAH (continued)

University of Utah
Library Periodical Room
Salt Lake City, Utah 84112

VERMONT

University of Vermont
Documents Librarian
Guy W. Bailey Library
Burlington, Vermont 15401

VIRGINIA

George Mason University
Fenwick Library
4400 University Drive
Fairfax, Virginia 22030

University of Virginia
Alderman Library
Public Documents
Charlottesville, Virginia 22903

Documents Department
Sven Library
College of William & Mary
Williamsburg, Virginia 23185

WASHINGTON

Washington State Library
Library Building
Olympia, Washington 98504

Washington State University
The Library
Serial Record Section
Pullman, Washington 99163

University of Washington
The Library
Documents Librarian
Seattle, Washington 98105

WISCONSIN

Milwaukee Public Library
Documents Division
814 West Wisconsin Avenue
Milwaukee, Wisconsin 53233

Documents Department
The Library
University of Wisconsin
Stevens Point, Wisconsin 54481

WYOMING

University of Wyoming
The Library
Documents Librarian
Laramie, Wyoming 82071

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 1 Ofc Chief of Stf, Studies Ofc
 1 DCSPER, ATTN: CPS/OCF
 1 The Army Lib, Pentagon, ATTN: RSB Chief
 1 The Army Lib, Pentagon, ATTN: ANRAL
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 1 US WAC Ctr & Sch, Ft McClellan, ATTN: Tng Dir
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 1 USA Air Def Bd, Ft Bliss, ATTN: STEBD-PO
 1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: Lib
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 1 USA Cmd & General Stf College, Ft Leavenworth, ATTN: Ed Advisor
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 1 USA Eng Sch, Ft Belvoir, ATTN: Library
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 1 USA Topographic Lab, Ft Belvoir, ATTN: STINFO Center
 1 USA Topographic Lab, Ft Belvoir, ATTN: ETL-GSL
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 1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-TE
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 1 USA Intelligence Ctr & Sch, Ft Huachuca, ATTN: ATSI-CTD-CS
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 1 Research Institute, HQ MASTER, Ft Hood
 1 USA Recruiting Cmd, Ft Sheridan, ATTN: USARCPM-P
 1 Senior Army Adv., USAFAGOD/TAC, Elgin AF Aux Fld No. 9
 1 HQ USARPAC, DCSPER, APO SF 96988, ATTN: OPPE-SE
 1 Stimson Lib, Academy of Health Sciences, Ft Sam Houston
 1 Marine Corps Inst., ATTN: Dean-MCI
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 1 USCG Training Ctr, NY, ATTN: Educ Svc Ofc
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1 US Marine Corps Liaison Ofc, AMC, Alexandria, ATTN: AMCGS-F
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 1 USA Air Def Sch, Ft Bliss, ATTN: ATSA TEM
 1 USA Air Mobility Resch & Dev Lab, Moffett Fld, ATTN: SAVDL-AS
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 1 USA Aviation Sch, CO, Ft Rucker, ATTN: ATST-D-A
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 1 HQ, USAMC, Alexandria, ATTN: CDR
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 1 Center of Naval Anal, ATTN: Doc Ctr
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 1 Denver Federal Ctr, Lakewood, ATTN: BLM
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 1 Centre de Recherche Des Facteurs Humains de la Defense Nationale, Brussels
 2 Canadian Joint Staff Washington
 1 C/Air Staff, Royal Canadian AF, ATTN: Pers Std Anal Br
 3 Chief, Canadian Def Resch Staff, ATTN: C/CRDS(W)
 4 British Def Staff, British Embassy, Washington
 1 Def & Civil Inst of Enviro Medicine, Canada
 1 AIR CRESS, Kensington, ATTN: Info Sys Br
 1 Militærpsykiologisk Tjeneste, Copenhagen
 1 Military Attache, French EmLassy, ATTN: Doc Sec
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 1 Ministerie van Defensie, DOOP/KL Afd Sociaal Psychologische Zaken, The Hague, Netherlands